SUMMARY REPORT

MONITORING OF WESTERN EQUINE ENCEPHALITIS CONTROL PROGRAM

1983

Environmental Management Division,
Manitoba Department of Environment,
Workplace Safety and Health.

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SUMMARY OF FINDINGS

1) The size and density of the droplets produced were for the most part in the range or close to the range desired.

2) There was a high degree of variability in spray deposit within localized areas of the spray blocks.

3) Caged test results indicate the program was effective in killing exposed mosquitoes (80 to 85% in open areas; 45-56% under shrubs).

4) Fifteen minute landing and biting counts were reduced to zero for 1 to 2 days after spraying but increased to pre-spray level after 4-5 days.

5) Post spray levels of malathion in drinking water were well below established guidelines.

6) Levels of malathion in unwashed lettuce increased substantially after spraying. Washing the lettuce significantly reduced the levels of malathion.

7) Natural degradation of malathion in lettuce is rapid.

8) Exposure to aerial spraying of malathion did not cause significant cholinesterase depression in test bird species.

9) Young walleye experienced brain cholinesterase inhibition of about 75% relative to pre-spray with no apparent mortality.

10) Caged test experiments showed honey bee mortality in excess of 80%.

11) Scale colony data indicated a reduction in honey production for at least 1-2 days following the spray for exposed colonies.

12) Leaf cutter bees showed 100% mortality in some spray zones.

13) Sixteen of the 253 blood samples from native birds were positive for WEE antibodies.

14) Caged mosquito and caged bee experiments indicate that spray drift occurred well beyond the spray zone.

15) Non-target insects (other than bees) studied were unaffected.

INTRODUCTION

On July 19, 1983 the Minister of Health declared a health emergency due to the threat of an outbreak of Western Equine Encephalitis (WEE) in several areas of the Province. As a result an aerial spray program designed to kill disease carrying mosquitoes was carried out in areas of high risk between July 23 and August 16, 1983. A list of the 31 communities sprayed is shown on page 5.

Cythion Ultra Low Volume concentrate (95% malathion) was chosen as the control agent. A specially equipped DC-6 aircraft was contracted to carry out the aerial application. The volumetric applicated rate was 210 ml/hectare (3 fl. oz/acre) from an altitude of 100 metres and an aircraft speed of 150 knots/hour. Flight lines were spaced at .8 Km intervals. Spraying operations were carried out during early morning and late evening hours when mosquitoes are most active.

In order to identify impacts on the environment and to assess the effectiveness of the program in controlling mosquito populations an environmental monitoring program was undertaken. Monitoring activities included:

1. Spray distribution, droplet size and application rates.
2. Effectiveness of the aerial spray program in controlling mosquito populations.
3. Malathion residues in surface drinking water supplies.
4. Malathion residues in vegetation.

5. Brain cholinesterase activity in native bird populations.
6. Cholinesterase activity in fish and corexid insects.
7. Effects of spray program on honey bees and leaf cutter bees.
8. Western Equine Encephalitis antibodies in blood of native birds.

The ensuing sections of this report present the data which has been collected and summarize the findings.

The present Summary Report is based upon the preliminary reports of each of these studies. Not all of the data is presented in this summary report, however, representative data is presented. A technical volume which contains all the data collected will be available upon request from the Department's Community Relations Branch, 960-330 St. Marys Avenue, Winnipeg.

LIST OF STUDY LEADERS

Spray Distribution, Droplet Size and Application Rates	Mr. Terry Youmans, Environmental Protection Services, Environment Canada.
Effectiveness of the Aerial Spray Program in Controlling Mosquito Populations	Dr. R. A. Brust, Dept. of Entomology, University of Manitoba.
Malathion Residues in Surface Drinking Water Supplies	Mr. D. R. Rocan, P. Eng., Environmental Management Division, Manitoba Department of Environment and Workplace Safety and Health.
Malathion Residues in Vegetation	Dr. S. Floyd Phillips, Environmental Management Division, Manitoba Department of Environment and Workplace Safety and Health.
Brain Cholinesterase Activity in Native Bird Population	Dr. E. Kucera, Environmental Management Division, Manitoba Department of Environment and Workplace Safety and Health.

Cholinestrerase Activity in Fish and Corexid Insects	Dr. W. L. Lockhart, Freshwater Institute, Canada Fisheries and Oceans .
Effects of Spray Program on Honey Bees & Leaf Cutter Bees	Mr. D. Dixon, Manitoba Department of Agriculture.
Western Equine Encephalitis Antibodies in Blood of Native Birds	Dr. E. Kucera, Environmental Management Division, Manitoba Department of Environment and Workplace Safety and Health.

HEALTH EMERGENCY (WEE) 1983 SPRAYING OPERATION PROGRAM

Place	Completed Date	Time
Winnipeg (East)	Sat. July 23	p.m.
Winnipeg (West)	Sun. July 24	a.m.
Winnipeg (Headingley)	Sun. July 24	p.m.
Steinbach/Ste. Anne	Sun. July 24	p.m.
Morden/Winkler	Mon. July 25	p.m.
Portage la Prairie	Tue. July 26	p.m.
Carman	Tue. July 26	p.m.
Selkirk	Wed. July 27	a.m.
Stonewall/Stoney Mountain	Wed. July 27	a.m.
Riverville	Wed. July 27	p.m.
Morris	Wed. July 27	p.m.
Altona	Thu. July 28	a.m.
Gimli/West Beaches	Thu. July 28	p.m.
Oakbank	Fri. July 29	a.m.
Dugald	Fri. July 29	a.m.
Beausejour	Fri. July 29	a.m.
Brandon	Fri. July 29	p.m.
Dauphin	Sat. July 30	a.m.
Virden	Sun. July 31	a.m.
Swan River	Sun. July 31	p.m.
Roblin	Sun. Aug. 7	a.m.
Russell	Sun. Aug. 7	a.m.
Deloraine	Mon. Aug. 8	a.m.
Melita	Mon. Aug. 8	a.m.
Minnedosa	Mon. Aug. 8	p.m.
Neepawa	Mon. Aug. 8	p.m.
Grandview	Tue. Aug. 9	a.m.
Ste. Rose du Lac	Tue. Aug. 9	a.m.
Boissevain	Tue. Aug. 9	p.m.
Killarney	Tue. Aug. 9	p.m.
Winnipeg West	Sat. Aug. 13	p.m.
Winnipeg Centre	Sun. Aug. 14	a.m.
Winnipeg East	Tue. Aug. 16	a.m.

SPRAY DISTRIBUTION, DROPLET SIZE AND APPLICATION RATES

Four locations in the province were selected for monitoring of the spray droplet sizes and application rates. These included Winnipeg, Stonewall, Gimli and Niverville. The logistics of the spray program did not permit droplet monitoring in all of the communities; however, it was felt that representative data could be obtained from these four. In Winnipeg, monitoring was done in 4 areas of the city, while in each of the other centres, only one area was monitored. All of these areas lay well within the spray block.

Monitoring sites were set up at 400 m. intervals along east-west transects established within the above areas, with the exception of two areas in Winnipeg where sites were 100 to 200 m. apart. Sites were located in open areas about 30 m. from the road, along routes which were felt to have a minimum of vehicular traffic.

At each monitoring station, Teflon-coated microscope slides (2.5 x 7.5 cm) were set out on 5 x 5 cm. stakes, 1-m. above ground-level and exposed for time periods ranging from 0.5 to 3.0 hours. In some cases the slides were set out on flat circular plastic trays approximately 30 cm. in diameter, and in other cases, the slides were attached directly to the top of the stakes.

After exposure to the spray cloud, the slides were collected and stored at $4^{\circ}C$ until examination, usually 4-16 hours later. The droplets were microscopically sized and counted under 150 to 250 power magnification using a calibrated eyepiece and a stage micrometer.

The mass median diameters (MMD) were determined using the procedure suggested by the manufacturer. A fixed area of 1.0-1.5 cm. x 3.5 cm. was examined on each slide. A fixed area was used since it facilitated calculation of the droplet density and application rates. In most cases, slides containing less than 30 droplets within the centre area were not included in the averages, except for Niverville where although all of the slides had a very light deposit, calculations were based on the available data.

The application rate was then calculated on the basis of the droplet numbers and volumes within the centre area of the slide.

Results are tabulated on page 9.

Summary of Results

1) There was a high degree of variability in spray deposit within localized areas of the spray blocks. There were large differences observed in application rates between stations along the same transect and even between adjacent slides at the same sampling station. Some areas such as Niverville appeared to have received very little spray deposit at ground level while other localized areas received up to 350 ml/ha, almost 70% more than intended. The average application rate ranged from 36 ml/ha to 161 ml/ha (excluding Niverville where the rate was not calculated).

2) The average mass median diameter of the droplets was fairly consistent from one sprayed area to the next ranging from 22 µm to 58 µm.

3) There was little or no apparent correlation between slide exposure time and the amount of malathion collected on the slides. For most transects, a 1 to 2 hour exposure time was found to yield the highest deposit rate, not the 3 hour exposure as one might expect. It was also expected that the 3 hour slides would have a higher percentage of smaller droplets (which remain airborne longer) but this did not seem to be the case. Most of the spray droplets had reached the ground within the first 2 hours.

4) The size and density of the droplets produced were for the most part in the range or close to the range desired. According to the manufacturer, effective aerial application requires droplet sizes in the range of 50-60 microns and a droplet density of 1.5 drops or more per square centimeter. No more than 10% of the droplets should be larger than 100 microns.

SUMMARY OF DROPLET MONITORING DATA - 1983
(Average of Results from Slides Exposed for 1 and 2 Hours)

TRANSECT LOCATION	DATE	MMD (μm) AVE.	MMD (μm) RANGE	D max. (μm)	Density (drops/cm^2) AVE.	Density (drops/cm^2) RANGE	Drops >100 μm[1] (%)	Application Rate (ml/ha) AVE.	Application Rate (ml/ha) RANGE
WINNIPEG									
- Selkirk Ave.	July 24 a.m.	46	25-74	120	18.7	3.1-46.6	<1 [2]	114	23-296
- Ft. Whyte Nature Centre	July 24 a.m.	22	10-34	120	22.9	3.7-68.3	<1	36	5-124
- Saskatchewan Ave.	Aug. 13 p.m.	38	10-70	146	35.4	7.2-80.4	Approx. 1	161	1-353
- Bishop Grandin Blvd.[3]	Aug. 14 p.m.	43	31-60	146	12.9	2.7-30.1	<1	87	8-354
STONEWALL	July 27 a.m.	45	36-52	130	19.5	4.9-42.6	<1	102	41-204
NIVERVILLE [4]	July 27 p.m.	43	10-70	134	5.0	0 - 9.7	<1	NOT CALCULATED [4]	
GIMLI	July 28 p.m.	58	45-72	135	10.5	3.4-22.6	3	136	39-211

NOTES (1) > = greater than
(2) < = less than
(3) 1 hour exposure time only
(4) All of the Niverville slides had a very light deposit of droplets (generally less than 30 per slide). Therefore the application rate was not calculated.

EFFECTIVENESS OF THE AERIAL SPRAY PROGRAM IN CONTROLLING MOSQUITO POPULATIONS

Three methods of evaluating the effectiveness of aerial spraying with malathion in reducing mosquito populations and in particular Culex tarsalis, were used:

1) Caged mosquitoes placed at .5 m. above ground level in open areas and under shrubs;
2) Landing biting counts on humans;
3) New Jersey light traps.

1. Caged Mosquitoes:

Culex tarsalis and Culex restuans females were used in most of the tests conducted. Aedes species, primarily Aedes vexans females were used in one set of tests. Twenty females were used per cage and the cages were tied to stakes and set .5 m. above ground in open areas and under shrubs. The cages were set in linear fashion usually 200 m. apart but occasionally 300 or 500 m. apart. One hour after spraying the caged mosquitoes were picked up and taken to the laboratory. Here they were held at 20°C for 24 to 48 hours and mortality readings were made every 12 hours.

To determine the mean mosquito mortality in caged mosquitoes under shrubs versus caged mosquitoes in open areas the cage was set at .5 m. above ground at both conditions.

A 64 cage grid design was used to determine if light spray swaths occurred and if these were common or rare. Linear cage placements perpendicular to the spray swath were also used to evaluate the distribution of the insecticide.

Results of the caged mosquito experiments are shown on pages 15 to 22.

2. Pre-Spray and Post-Spray Landing Biting Counts on Human Hosts

Landing-biting rates were determined in Winnipeg, St. Adolphe and Ile des Chenes for 8-10 evenings between July 20 and August 1. All participants in the experiment wore grey coveralls, collected at the same location each night and captured all the mosquitoes landing on the front of their body. All collections were made between 2130 and 2145 hours each night.

Results of pre-spray and post-spray landing biting counts are shown on pages 23 to 26. The corrected % reduction takes into account the reduced landing biting rate during the post-spray period in the control area.

3. **New Jersey Light Trap Collections:**

To determine their effectiveness as a method of evaluating mosquito control six New Jersey light traps (25 watt lamp) were set up on July 20 and 21 in Fort Garry and St. Vital, inside the spray zone and six traps were set up outside of the anticipated spray zone in Ile des Chenes, Lorette, Landmark, Niverville, Ste. Agathe and St. Adolphe.
East Winnipeg, including the Fort Garry and St. Vital sites was sprayed on July 23 and August 16 and Niverville was sprayed on July 27. The other communities outside of Winnipeg were not sprayed but it appears St. Adolphe and Ile des Chenes did receive spray drift from Winnipeg on July 23.

Results of these experiments are shown on pages 27 to 30.

Summary of Results:

1) The Malathion aerial spray to control mosquito vectors of Western Equine Encephalitis resulted in killing 80 to 85% of caged Culex tarsalis females when cages were placed in open areas (no tree canopy); 45-56% of caged mosquitoes placed under shrubs were killed by the spray.

2) Aedes mosquitoes may be used to evaluate control of mosquito vectors of Western Equine Encephalitis in Manitoba. Aedes mortality was virtually identical to Culex mortality.

3) "Light" application zones in the spray swaths were detected in each of the communities tested. When cages were placed in a linear pattern 200 or 300 m. apart mosquito mortality ranged from 6-100%. When an 8 x 8 grid of 64 cages was used, the rows of cages placed parallel to the spray swath showed different mean mosquito mortality indicating a layering and thinning effect of the spray swaths.

4) The spray reduced the landing and biting (15 minute) count to zero for 1 to 2 days following spraying. The counts increased after 4-5 days to pre-spray levels. Culex tarsalis females came to bite again on the 5th day after spraying.

5) Use of New Jersey light traps was not as useful a technique as the other two methods used to assess the effect of spraying to reduce mosquito populations. The trap collections varied greatly from night to night at the same location and this tends to cancel out the trend shown at individual trap sites.

Effect of the Malathion aerial spray on caged female Culex mosquitoes in open areas (Standard, rectangular cage)

Date	Location	No. Test Cages	Mosquito Mortality (%)			
			After 12 hrs.	24 hrs.	24 hr. Control Mortality	Corrected 24 hr. Mortality
July 23 PM	East Winnipeg	18	56.7	67.2	1.6	65.6
July 24 AM	West Winnipeg	8	78.2	81.8	0	81.8
July 28 PM	Gimli	9	77.4	94.9	0	94.9
July 29 AM	Dugald Oak Bank	9	95.3	99.4	0	99.4
July 29 AM	Beausejour	15	77.4	83.6	0	83.6
July 29 PM	Brandon	9	63.8	86.8	0.8	86.0
July 30 AM	Dauphin	9	84.7	90.5	*	-
July 31 AM	Swan River	9	75.1	88.7	0	88.7
Aug. 8 PM	Neepawa	14	85.1	92.7	3.6	89.1
Aug. 13 PM	West Winnipeg	20	85.8	89.5	0.7	88.8
Aug. 16 AM	East Winnipeg	19	70.6	87.9	1.6	86.3
Mean Culex mortality in rectangular cages			76.4	86.4	1.1	85.3

*Controls downwind of spray.

Effect of the Malathion Aerial Spray on caged *Aedes* mosquitoes in open areas (rectangular cage)

Date	Location	No. Test Cages	Mosquito Mortality (%)			
			After 12 hrs.	24 hrs.	24 hr. Control Mortality	Corrected 24 hr. Mortality
July 23 PM	East Wpg.	64	76.5	82.5	10.0	72.5
July 24 AM	West Wpg.	14	95.0	97.2	5.6	91.6
July 27 AM	Selkirk	9	97.8	98.9	18.0	80.9
July 27 AM	Stonewall	9	96.7	99.5	3.4	96.1
July 27 AM	Niverville	9	83.4	93.9	10.0	83.9
July 28 AM	Altona	9	85.4	92.1	5.3	86.8
Mean *Aedes* mortality in rectangular cages			84.0	89.2	7.9	81.3

Percent mortality in caged Culex mosquitoes after 24 hours. At each site, one cage was in the open and one was under shrub(s).

Date	Location	Site	Mosquito Mortality (%)		
			Open Site	Under shrub	Control
Aug. 8 PM	Neepawa	1	100	95	21
		2	100	42	0
		3	100	76	0
		4	100	47	0
		5	100	40	4.5
		6	100	59	10.5
		7	90	95	
		8	85	62	
		9	90	95	
		10	84	58	
		11	100	24	
		12	80	24	
		13	100	14	
		14	100	70	
		15	100	45	
		16	87	85	
		17	92	22	
		18	42	39	
		19	52	35	
		20	95	21	
		21	71	35	
Mean % mortality			88.5	51.1	5.5
Corrected mean mortality			83.0	45.6	

Percent mortality in caged Culex mosquitoes after 24 hours. At each site, one cage was in the open and one was under shrub(s).

Date	Location	Site	Mosquito mortality (%)		
			Open site	Under Shrub	Control
Aug. 13 PM	West Winnipeg	1	100	84	0
		2	100	21	1
		3	100	29	0
		4	86	6	0
		5	100	25	0
		6	95	60	0
		7	100	100	1
		8	81	25	
		9	100	28	
		10	95	90	
		11	55	16	
		12	100	89	
Mean % mortality			91.6	48.1	0.71
Corrected mean mortality			90.9	47.4	

rercent mortality in caged Culex mosquitoes after 24 hours. At each site, one cage was in the open, and one under shrub(s).

Date	Location	Site	Mosquito mortality (%)		
			Open Site	Under Shrubs	Control
Aug. 16 AM	East Winnipeg	1	85	44	0
		2	95	95	10
		3	63	29	5
		4	80	80	0
		5	100	43	0
		6	75	37	0
		7	94	60	
		8	95	80	
		9	95	42	
		10	95	71	
		11	100	71	
		12	89	6	
		13	61	23	
		14	100	60	
		15	81	60	
		16	100	96	
		17	91	100	
Mean % mortality			88.1	59.0	2.5
Corrected mean mortality			85.6	56.5	

Percent mortality of caged Aedes mosquitoes after 24 hrs., at 64 stations. Stations 500m apart, in an 8 X 8 grid pattern, in open areas. Mean mortality 82.5%.

North

Springfield Road

									Row	Mean
	74	100	70	100	47	100	100	55	1	81
	100	90	100	100	33	100	100	11	2	79
	100	100	83	100	89	100	71	6	3	81
	65	100	100	100	81	100	100	35	4	89
West	37	85	89	100	68	91	100	-	5	81
	30	42	100	100	80	90	100	68	6	76
	83	100	76	100	65	100	100	100	7	90
	94	95	-	100	61	50	95	100	8	85
		Pandora Avenue, Transcona, East Winnipeg								
Column	1	2	3	4	5	6	7	8		
Mean	73	89	88	100	65	91	96	54		

Plessis Road

East

North-South Flight Direction

Percent mortality in caged mosquitoes after 24 hours. Stations were 200 m apart, in a linear pattern, and in open areas.

Date	Location	Stations 1	2	3	4	5	6	7	8	9	10	11
		AEDES Mosquitoes										
July 27 AM	Selkirk	100	100	100	100	100	95	100	90	95	-	-
July 27 AM	Stonewall	100	100	100	100	95	100	100	100	100	-	-
July 27 PM	Niverville	100	100	84	75	95	100	100	95	95	-	-
July 28 AM	Altona	95	100	100	100	100	89	100	100	45	-	-
		CULEX Mosquitoes										
July 28 PM	Gimli	72	95	100	89	100	100	95	100	100	-	-
July 29 AM	Dugald	100	100	100	100	100	100	100	94	100	-	-
July 29 AM	Oakbank Beausejour	94	100	80	100	21	76	60	63	58	100	100
July 29 PM	Brandon	95	100	68	71	79	70	100	100	100	-	-
July 30 AM	Dauphin	100	50	100	96	68	100	100	100	100	-	-
July 31 PM	Swan River	100	70	89	74	90	95	89	90	100	-	-

Percent mortality in caged Culex mosquitoes after 24 hours.
Stations were 300 m apart, in open areas.

Date	Location	Stations 1	2	3	4	5	6	7	8	9	10	11
Aug. 8 PM	Neepawa	100	100	100	100	100	100	90	85	90	84	100
Aug. 13 PM	West Winnipeg	100	100	100	86	100	96	100	81	100	95	55
Aug. 16 AM	East Winnipeg	85	95	63	80	100	75	94	95	95	95	100

Date	Location	Stations 12	13	14	15	16	17	18	19	20	21	22
Aug. 8 PM	Neepawa	80	100	100	100	87	92	42	52	95	71	81
Aug. 13 PM	West Winnipeg	100	100	11	100	56	100	100	100	100	-	-
Aug. 16 AM	East Winnipeg	89	61	100	81	100	91	95	91	-	-	-

Pre-Spray and Post-Spray daily Mosquito landing-biting counts (2130-2145h) on humans.

Pre-spray dates	Airport Temperature and Relative Humidity at 2100 h	East Winnipeg (Fort Garry)			Mean No. Collector Night	
		Kilkenny and Red River	Silverstone and Dalhousie	Somerset and Point Road		
July 20/83	24°C 40%	112	14	34		
21	24°C 42%	87	9	26	33.2	
22	21°C 29%	17	10	16		
23	18°C 62%	33	25	16		
Post-spray dates	**Aerial spraying conducted 1930-2130 h, 23 July**				**% Reduction**	**Corrected % Reduction**
July 24	24°C 28%	0	0	0	100	100
25	26°C 27%	0	0	0	100	100
26	25°C 53%	18	2	0	87.3	68
27	22°C 81%	3	0	2		
31	20°C 63%	-	33	-		
Aug. 1	24°C 38%	-	34	-		

Pre-spray and Post-spray daily mosquito landing-biting counts (2130-2145h) on humans.

Pre-spray dates	Airport temperature and relative humidity at 2100 h	WEST WINNIPEG (Garden City, St. James-Assiniboia)				MEAN No./ Collector/ Night
		Peony and Verbena	Sturgeon Road	Omands Creek and Assiniboine R.	Assiniboine R. and Perimeter Hwy.	
July 20/83	24°C 40%	10	8	7	33	
21	24°C 42%	36	41	155	41	34.6
22	21°C 29%	21	5	18 (1)	31	
23	18°C 62%	57 (3)	56	13	22	
Post-spray dates	Aerial spraying conducted 600-800h, 24 July					
July 24	24°C 28%	4	14	-	17	12 h partial spray effect
						% Reduction / Corrected % Reduction
25	26°C 27%	0	0	0	0	100 / 100
26	25°C 53%	0	3	3	0	96 / 89
27	22°C 81%	0	3	3	2	94 / 85
28	22°C 41%	6	9	8	2	82 / 54
29	22°C 15%	16 (2)	17	-	-	

Culex tarsalis (parentheses)

Pre-spray and post-spray daily mosquito landing-biting counts (2130-2145 h) on humans.

Pre-spray dates	Airport temperature and relative humidity at 2100 h	St. Adolphe (5 km. south of spray zone)	Ile des Chenes (7 km. south of spray zone)	Mean No./ collector/ night
July 20	24°C 40%	36 (2)	71 (3)	
21	24°C 42%	91	80	67.9
22	21°C 29%	45 (1)	28	
23	18°C 62%	68 (9)	124	
Post-spray dates	Aerial spraying 5 - 7 km north of collecting sites, 1930 - 2130 h on 23 July. 16 km/h north-northwest wind.			
July 24	24°C 28%	6 (2) *	21	
July 25	26°C 27%	0 *	21	
July 26	25°C 53%	90 **	31 (4)	26.8
July 27	22°C 81%	20	25	
July 28	22°C 41%	19	16	
July 29	22°C 15%	34	20 (1)	

* Spray drift downwind likely responsible for this reduction.

** Reinvasion by migrating A. vexans is the likely reason for this increase.

culex tarsalis (parentheses)

Mosquito species collected in landing-biting survey July 20 - August 1, 1983.

Pre-spray dates	7 Winnipeg locations			St. Adolphe, Ile des Chenes		
	Species	No.	%	Species	No.	%
20-23 July	Aedes vexans	749	79.8	Aedes vexans	421	76.3
	Aedes spp.	186	19.8	Aedes spp.	116	21
	Culex tarsalis	4	0.4	Culex tarsalis	15	2.7
	Others	0		Others	0	
	Total	939		Total	552	
Post spray dates						
24-27 July	Aedes vexans	60	84	Aedes vexans	190	88.8
	Aedes spp.	9	13	Aedes spp.	17	7.9
	Culex tarsalis	0		Culex tarsalis	6	2.8
	Others	2	3	Others	1	0.5
	Total	71		Total	214	
28 July - 1 August	Aedes vexans	119	78	Aedes vexans	34	38
	Aedes spp.	33	21.4	Aedes spp.	55	61
	Culex tarsalis	2	1.2	Culex tarsalis	1	1
	Others	0		Culex tarsalis	0	
	Total	154		Total	90	

New Jersey light trap collections outside of Winnipeg under pre-spray and post-spray conditions.

Date	Ile des Chenes		Lorette		Landmark		Niverville		Ste Agathe		St Adolphe		Combined outside collection		Mean # of females per trap/night	
	c. t.	total	c. t.	total	c. t.	total	c. t.	total	c. t.	total	c. t.	total	c. t.	total	c. t.	total
July 21/83	48	309					213	1565	147	224	39	175	447	2273	111.8	568.3
22	13	747	0	613	48	385	143	459	68	242	7	146	279	2592	46.5	432
23	5	142	20	123	13	105	53	168	76	122	14	66	181	726	30.2	121
24	22	231	7	68	18	159	51	124	27	80	11	69	136	731	22.7	121.8
25	4	55	0	87	15	98	10	29	7	28	0	5	36	302	6	50.3
26	3	14	4	107	3	35	12	98	4	60	0	21	26	335	4.3	55.8
27	105	185	4	361	37	322	49	138	13	79	4	41	212	1126	35.3	187.7
28	19	49	3	72	44	139	45	71	19	40	5	23	133	394	22.2	65.7
29	0	7	4	38	11	97	4	20	27	44	1	10	47	216	7.8	36
30	4	25	3	42	13	155	16	56	31	215	4	34	71	527	11.8	87.8
31	0	7	3	9	3	13	14	31	14	24	4	11	38	95	6.3	15.8
Aug. 1	4	19	0	5	35	86	23	55	32	46	1	9	95	220	15.8	36.7
2	7	40	3	38	32	63	102	130	4	38	1	11	149	320	24.8	53.3
3	18	58	0	36	32	63	96	208	37	120	2	22	185	507	30.8	84.5
4	15	67	3	35	63	230	129	142	22	99	5	96	237	669	39.5	111.5
5	0	97	3	200	77	295	65	425	31	380	16	110	192	2176	32	362.7
6	15	32	5	17	4	70	45	78	3	61	3	11	75	269	12.5	44.8
7	46	152	28	252	32	359	11	27	48	260	4	44	169	1094	28.2	182.3

c. t. = culex tarsalis
total = total females

New Jersey light trap collections outside of Winnipeg under pre-spray and post-spray conditions.

Date	Ile des Chenes		Lorette		Landmark		Niverville		Ste Agathe		St Adolphe		Starbuck		Combined outside collection		Mean # of females /trap/nigh	
	c.t.	total	c.t.	total	c.t.	total	c.t.	total	c.t.	total	c.t.	total	c.t.	total	c.t.	total	c.t.	tota
Aug. 8/83	7	33	1	22			21	66	15	22	5	18	36	145	85	328	14.2	54.7
9	11	54	1	30	10	60	50	100	3	12	1	6	16	56	101	351	14.4	50.1
10	13	44	3	33	18	30	53	87	8	23	2	13	25	55	132	314	18.9	44.9
11	12	29	4	15	2	14	42	62	4	11	6	10	23	53	92	227	13.1	32.4
12	17	33	4	24	22	29	67	96	2	11	4	16	14	72	120	314	17.1	44.9
13	72	148	4	44	21	50	34	90	13	37	4	30	28	50	176	482	25.1	68.9
14	6	32	0	17	6	32	23	33	10	16	10	25	10	52	65	240	9.3	34.3
15	17	62	6	51	19	55	34	98	2	31	4	21	32	98	114	449	16.3	64.1
16	17	79	2	26	3	13	23	93	2	16	4	21	10	146	61	427	8.7	61.0
17	3	26	0	4	3	9	11	36	1	3	0	6	4	9	22	126	3.1	18.0
18	2	32	0	21	2	12	8	54	1	14	0	10	5	47	18	316	2.6	45.1
19	14	96	4	72	8	122	16	134	3	33	4	21	5	52	54	563	7.7	80.4
20	4	70	1	22	2	14	7	46	0	9	0	8	0	104	14	306	2.0	43.7
21	0	37	0	14	1	17	11	75	0	6	1	20	2	31	15	233	2.1	33.3
22	0	13	1	8	1	14	5	14	1	6	1	6			9	61	1.5	10.2

c.t. = culex tarsalis
total = total females

New Jersey light trap collections inside Winnipeg under pre-spray and post-spray conditions.

Date	University		Winslow Dr.		Dunkirk		Brookhaven		Dawson Rd.		Perimeter 100 and #59		Combined inside collection		Mean # of females /trap/night	
	c. t.	total	c. t.	total	c. t.	total	c. t.	total	c. t.	total	c. t.	total	c. t.	total	c. t.	total
July 21/83	1	12	2	5									3	17	1.5	8.5
22	7	51	3	23	0	84	0	53	14	20	8	244	32	475	5.3	79.2
23	0	19	1	11	0	6	0	27	0	4	5	49	6	116	1.0	19.3
24 spray	4	15	2	13	0	13	0	6	0	0	8	29	14	76	2.3	12.7
25	3	9	0	3	0	2	0	11	0	0	3	23	6	48	1.0	8.0
26	0	20	0	3	1	5	0	7	0	2	0	29	1	66	0.2	11.0
27	1	13	1	2	1	9	1	8	2	8	22	42	28	82	4.8	13.8
28	0	2	0	5	0	6	0	2	2	3	4	13	6	31	1.0	5.2
29	0	5	1	4	0	7	0	7	1	4	1	4	3	31	0.5	5.2
30	0	4	0	4	0	11	0	0	0	6	4	28	4	53	0.8	8.8
31	2	2	2	7	0	1	0	0	1	1	4	6	9	17	1.5	2.8
Aug. 1	4	9	9	12	7	20	2	9	2	5	18	34	42	89	7.0	14.8
2	8	8	1	3	2	12	1	4	0	1	20	29	33	57	5.5	9.5
3	5	7	7	17	2	15	3	8	5	15	25	97	47	159	7 8	26.5
4	17	19	2	32	0	38	1	6	0	7	38	102	58	204	9.8	34.0
5	26	39	8	57	2	32	2	18	9	37	36	103	83	319	13.8	53.2
6	4	10	0	7	0	26	2	9	2	9	1	40	9	91	1.5	15.2
7	12	89	20	66	2	26	2	14	0	3	36	89	72	287	12.0	47.8

c. t. = culex tarsalis
total = total females

New Jersey light trap collections inside Winnipeg under pre-spray and post-spray conditions.

Date	University		Winslow Dr.		Dunkirk		Brookhaven		Dawson Rd.		Perimeter 100 and #59		Combined inside collection		Mean # of females /trap/night	
	c. t.	total	c. t.	total	c. t.	total	c. t.	total	c. t.	total	c. t.	total	c. t.	total	c. t.	total
Aug. 8	40	67	13	18	2	8	0	4	16	45	18	55	89	220	14.8	36.8
9	5	17	0	6	3	30	2	11	0	35	11	35	21	134	3.5	22.3
10	0	4	0	2	3	5	2	5	5	11	9	33	19	60	3.2	10.0
11	0	10	1	2	2	13	0	3	3	24	14	31	20	83	3.3	13.8
12	3	14	0	0	0	6	0	2	3	8	19	30	25	60	4.2	10.0
13	10	27	6	13	1	9	0	9	1	14	11	69	29	174	4.8	29.0
14	5	31	1	6	5	31	0	11	2	19	10	30	23	128	3.8	21.3
15	1	5	0	3	0	3	0	5	0	2	3	32	4	50	0.8	8.3
16 spray	3	8	0	2	1	2	0	3	0	27	5	21	9	63	1.5	10.5
17	0	3	0	1	0	1	0	0	0	3	2	7	2	15	.3	2.5
18	0	4	0	4	0	1	0	6	0	10	2	10	2	35	.3	5.8
19	1	3	0	5	0	0	1	4	0	0	5	14	7	26	1.2	4.3
20	1	13	0	2	0	2	0	3	0	15	1	10	2	45	.3	7.5
21	0	2	0	1	0	1	0	2	0	31	8	21	8	58	1.3	9.8
22	0	1	1	1	0	1	0	6	1	18	0	14	2	41	.3	6.8

c. t. = culex tarsalis
total = total females

MALATHION RESIDUES IN SURFACE DRINKING WATER SUPPLIES

Water samples were taken at all communities involved in the spray program which utilize a surface supply for domestic purposes. A sample was taken at each site prior to spraying and within 24, 48 and 72 hours of the spraying of the communities.

Samples were taken from 3 locations at each facility sampled. The first was a surface sample taken at the .3 m. depth near the intake of the water treatment facility. The second and third samples were taken from raw and treated water sample taps within the water treatment plant.

The pH, temperature and time of sampling were recorded at each sampling location and the samples were then immediately refrigerated and shipped to the laboratory for analysis.

Results of the water analysis are tabulated on pages 33 to 35.

GUIDELINES FOR MALATHION IN DRINKING WATER

The Guidelines for Canadian Drinking Water Quality 1978 state that where pesticides are present in a drinking water supply the sum of their concentrations should not exceed 100 µg/L

The Safe Drinking Water Committee of the United States National Research Council (1977) have established the suggested no-adverse-effect level of malathion in drinking water at 160 µg/L. (this value incorporates a safety factor of 10).

Summary of Results:

1) All results were below the established guidelines of 100 µg/L and 160 µg/L referenced above.

2) All pre spray samples were less than the detectable level of .20 µg/L

3) The post spray values ranged from less than detectable to 37.0 µg/L. in surface water; 35.0 µg/L from the raw water tap; and .71 µg/L from the treated water tap.

MALATHION RESIDUES IN SURFACE DRINKING WATER SUPPLIES (µg/L)

	COMMUNITY/SOURCE	Date Sprayed	Pre-Spray	24-hr.	48-hr	72-hr
1)	Boissevain	August 9/83 (p.m.)				
	Reservoir Surface Sample		<0.20	1.77	0.80	0.48
	Raw at W.T.P.		<0.20	1.26	0.92	0.42
	Treated at W.T.P.		<0.20	<0.20	0.21	<0.20
2)	Brandon	July 29/83 (p.m.)				
	Raw at W.T.P.		<0.20	<0.20	<0.20	<0.20
	Treated at W.T.P.		<0.20	<0.20	<0.20	<0.20
	Assiniboine R. at 12th St. Bridge		<0.20	<0.20	<0.20	<0.20
3)	Carman	July 26/83 (p.m.)				
	Boyne River - Surface		<0.20	4.22	2.01	1.10
	Boyne River - Depth		<0.20	2.67	1.83	1.32
	Treated at W.T.P.		<0.20	<0.20	<0.20	0.71
4)	Dauphin	July 30/83 (a.m.)				
	Jackson Reservoir		<0.20	<0.20	<0.20	<0.20
	Booster Station		<0.20	<0.20	<0.20	<0.20
	Edwards Reservoir		<0.20	<0.20	<0.20	<0.20
5)	Deloraine	August 8/83 (a.m.)				
	Turtle Head Creek - Surface		<0.20	0.78	0.44	<0.20
	Raw at W.T.P.		<0.20	<0.20	<0.20	<0.20
	Treated at W.T.P.		<0.20	<0.20	<0.20	<0.20
6)	Grandview	August 9/83 (a.m.)				
	Valley River - Surface		<0.20	0.69	0.61	0.34
	Raw at W.T.P.		<0.20	0.53	0.66	0.33
	Treated at W.T.P.		<0.20	<0.20	<0.20	<0.20
7)	Killarney	August 9/83 (p.m.)				
	Killarney Lake - Surface		<0.20	0.92	0.39	0.30
	Raw at W.T.P.		<0.20	1.34	0.52	0.30
	Treated at W.T.P.		<0.20	<0.20	<0.20	0.20
8)	Lockport	July 23-24/83 (WPg)				
	Red River - Surface		<0.20	<0.20	—	1.70
	Red River - Depth		<0.20	<0.20	—	2.20

COMMUNITY/SOURCE	Date Sprayed	Pre-Spray	24-hr.	48-hr	72-hr
9) Morden	July 25/83 (p.m.)				
Lake Minnewasta - Surface		<0.20	2.24	2.06	0.58
Raw at W.T.P.		<0.20	<0.20	1.04	<0.20
Treated at W.T.P.		<0.20	<0.20	<0.20	<0.20
10) Morris	July 27/83 (p.m.)				
Red River - Surface		<0.20	<0.20	<0.20	<0.20
Raw at W.T.P.		<0.20	<0.20	<0.20	<0.20
Treated at W.T.P.		<0.20	<0.20	<0.20	<0.20
11) Neepawa	August 8/83 (p.m.)				
Lake Irwin - Surface		<0.20	0.74	<0.20	<0.20
Raw at W.T.P.		<0.20	<0.20	<0.20	<0.20
Treated at W.T.P.		<0.20	<0.20	<0.20	<0.20
12) Portage la Prairie	July 26/83 (p.m.)				
Assiniboine River - Surface		<0.20	3.08	0.68	0.23
Assiniboine River - Depth		<0.20	4.06	0.80	0.21
Treated at W.T.P.		<0.20	0.54	<0.20	<0.20
13) Portage la Prairie	July 26/83 (p.m.)				
Assiniboine River Diversion		<0.20	4.65	2.29	2.02
Assiniboine R. Div. PTH 249		<0.20	1.43	0.80	0.31
Assiniboine R. PTH 227		<0.20	2.33	0.78	0.23
14) Rivers	(not sprayed)				
River Sample - Surface		<0.20	--	--	--
Raw at W.T.P.		<0.20	--	--	--
Treated at W.T.P.		<0.20	--	--	--
15) Russell	August 7/83 (a.m.)				
Reservoir - Surface		<0.20	6.24	2.00	0.83
Raw at W.T.P.		<0.20	3.51	1.95	1.25
Treated at W.T.P.		<0.20	<0.20	<0.20	<0.20
16) Selkirk	July 27/83 (a.m.)				
Red River - Surface		<0.20	2.17	<0.20	<0.20
17) Souris	(not sprayed)				
Souris River at Bridge		<0.20	--	--	--
Raw at W.T.P.		<0.20	--	--	--
Treated at W.T.P.		<0.20	--	--	--

COMMUNITY/SOURCE	Date Sprayed	Pre-Spray	24-hr.	48-hr	72-hr
18) Ste. Rose du Lac	August 9/83 (a.m.)				
Turtle River - Surface		<0.20	37.0	12.0	7.72
Raw at W.T.P.		<0.20	35.0	15.0	8.47
Treated at W.T.P.		<0.20	<0.20	<0.20	<0.20
19) Winnipeg	July 23-24/83				
Shoal Lake Aqueduct		<0.20	<0.20	--	<0.20
Deacon Reservoir - Surface		<0.20	0.48	--	0.35
Deacon Reservoir - Depth		<0.20	<0.20	--	<0.20
20) Winnipeg					
Hurst Reservoir - Surface		<0.20	1.68	--	0.83
Hurst Reservoir - Depth		<0.20	1.76	--	0.86
21) Winnipeg					
Fort Garry Nature Centre Lake #4		<0.20	5.03	6.16	2.60
22) City of Winnipeg 2nd Spraying					
Hurst Reservoir -	August 14/83 (a.m.)				
Surface		--	--	--	0.28
Depth		--	--	--	0.32
Deacon Reservoir -	August 16/83 (a.m.)				
Surface		<0.20	<0.20	<0.20	--
Depth		<0.20	<0.20	0.23	--

MALATHION RESIDUES IN VEGETATION.

Leaf lettuce was chosen as the primary sampling substrate for the following reasons:

1) It is grown in most gardens.

2) It has a relatively large surface area, a pre-requisite of a good receptor.

3) The edible parts of the plant are exposed to the spray.

4) It is eaten with no preparation except washing.

Samples were collected from eleven locations in the City of Winnipeg plus a control site in the Birds Hill area. Samples were collected from each of the spray events in Winnipeg. Samples were also collected in 14 other communities in Southern Manitoba where the spraying took place.

Pre-spray samples were collected before the spraying occurred to determine the background levels. Post-spray sampling was carried out between 20 minutes and 2 hours after the spray plane passed each sample location.

Four gardens in Winnipeg were monitored over a longer period of time to check the rate of malathion degradation under field conditions. A second sample was collected 2 to 5 days after the spray event and a third and fourth at 7 and 14 days respectively.

An unwashed and washed sample was collected from each garden provided that enough lettuce was available. If there was insufficient material in the garden only a washed sample was collected. Samples were washed 5 or 6 times by alternately rinsing with tap water and

squeezing the water out. To prevent the breakdown of malathion the samples were frozen within 5 minutes of collection, by placing them in a cooler lined with dry ice (-78°C) and subsequently transferred to a -45°C freezer pending analysis.

Sampling locations and results are tabulated on pages 39 to 42.

Guidelines

The Food and Drug Directorate of Health and Welfare Canada has established a residue tolerance level for malathion in lettuce of 6 µg/g. This represents a level which should not be exceeded if proper methods are followed when applying malathion to the crop for insect control purposes.

The Safe Drinking Water Committee of the United States National Research Council (1977) have cited studies involving humans that concluded that up to 16000 µg (16 mg) of malathion may be ingested daily for up to 47 days with no significant effects.

The World Health Organization has established an acceptable daily intake of 1000 µg for Malathion. This is the amount of malathion that toxicologists consider to be safe for humans to consume each day for an entire lifetime.

Summary of Results

1) Increased levels of malathion were found in lettuce following the spray program. The average post spray concentration in unwashed lettuce from Winnipeg was 6.66 µg/g (range 0.164 to 15.6) and from other communities 7.47 µg/g (range <0.002 to 20.6). One post-spray sample from the Winnipeg area had an unusually high level of 78.4 µg/g.
2) Washing the lettuce significantly reduced the malathion levels. The average concentration in washed lettuce from Winnnipeg was .78 µg/g (range -084 to 2.70) and from other communities .89 µg/g (range <.002 to 3.89)
3) Natural degradation of malathion in lettuce is rapid, resulting in a 50% reduction in the initial 48 hour period and almost total degradation in 14 days.

Lettuce Sampling Locations.

Location	Location Number
Winnipeg	
118 Carlotta	1
181 Athlone	2
74 Deerlodge Place	3
139 Tuxedo (FOC)	4
515 Jessie	5
145 Woodlawn	6
1476 Chancellor	7
103 Bridgecrest	8
167 Syndicate	9
359 Headmaster	10
Dunning Rd - Birds Hill (control)	11
27 Christenson	12

Southern Manitoba cities/towns	Number of sampling locations
Steinbach	3
Beausejour	3
Stonewall	3
Selkirk	5
Portage La Prairie	6
Carman	4
Morden	3
Winkler	3
Altona	3
Morris	2
Brandon	5
Virden	2
Dauphin	4
Swan River	3

Malathion concentration (ug/g) in lettuce samples collected from backyard gardens in Winnipeg.

LOCATION	Loc. No.	First Spray Event			
		Pre-Spray		Post-Spray	
		unwashed	washed	unwashed	washed
103 Bridgecrest	8			0.164	0.136
359 Headmaster	10	<0.002		10.6	1.98
167 Syndicate	9	0.002	0.002	78.4	0.605
515 Jessie	5	0.055	0.005	15.6	1.95
145 Woodlawn	6	0.005	0.010	2.58	0.319
1476 Chancellor	7	0.038	0.003	4.38	0.184
139 Tuxedo	4	0.005	<0.002	-	0.084
74 Deerlodge Pl.	3		<0.002	-	0.711
27 Christenson	12	<0.002	0.020	-	2.70
118 Carlotta	1	0.012	<0.002	-	0.471
181 Athlone	2	<0.002	<0.002	-	0.216
Birds Hill	11	<0.002	<0.002		0.122

Average concentrations of malathion in lettuce with associated ranges (µg/g).

	Pre-spray				Post-spray			
	Unwashed		Washed		Unwashed		Washed	
Location/Description	Mean	Range	Mean	Range	Mean	Range	Mean	Range
Winnipeg - all	0.012	<0.002-0.005	0.004	<0.002-0.020	6.66 *	0.164-15.6 *	0.78	0.084-2.
Southern Manitoba**	0.092	<0.002-1.33	0.002	<0.002-0.005	7.47	<0.002-20.6	0.89	<0.002-3.

*Excluding outlier value of 78.4 µg/g.

**Not including City of Winnipeg.

Post-spray degradation of malathion
in lettuce under natural conditions (µg/g).

LOCATION	Loc. No.	1 hour		2-5 days		7 days		14 days	
		UW	W	UW	W	UW	W	UW	W
181 Athlone	2	-	0.215	0.207(5)	0.116	0.007	-	<0.002	-
27 Christenson	12	-	0.584	0.090(4)	0.013	0.199	<0.002	0.048	0.003
359 Headmaster	10	8.80	3.24	1.74(2)	0.467	0.013	0.008	0.005	-
103 Bridgecrest	8	11.7	4.02	5.53(2)	0.753	0.061	0.024	0.016	0.008

( ) Days since malathion spray application.
UW - unwashed sample.
W - washed sample.

BRAIN CHOLINESTERASE ACTIVITY IN NATIVE BIRD POPULATIONS

Malathion is an organophosphorus compound with known ability to inhibit cholinesterase enzymes. These enzymes occur in the nervous system and are used in the transmission of nerve impulses from one neuron cell to the next. When the enzyme no longer functions in its normal role, nervous control of muscles is lost. The consequence of this in vertebrates is that muscles required for breathing stop functioning and the animal dies of asphyxiation.

Wild birds were tested before and after malathion spraying to assess the effects of spray on brain cholinesterase (ChE) levels. In total 41 sparrows and 39 pigeons were collected within the City of Winnipeg for analysis of brain ChE activity. Of these, 10 sparrows and 9 pigeons were analyzed prior to spraying to provide an indication of background levels of brain ChE.

Caged sparrows were exposed to aerial spraying of malathion on July 24, 1983 at Fort Whyte Nature Centre in Winnipeg. Brains were collected 6 hrs., 12 hrs., and 26-27 hrs. after spraying. Additional sparrows were collected in the St. James area 8, 15 and 16 days after spraying. Pigeons were collected 25-26 hrs., 9 days and 15 days after spraying from the River Heights area. Brains were preserved frozen pending analysis.

In addition, contact was made with members of the Rare Bird Alert group of the Manitoba Naturalists Society to keep a close watch and report any abnormal bird behaviour or mortality during and after the spray operation. Careful attention was also given to any submissions or reports of bird or small mammal mortality from citizens of any of the designated spray areas.

Results are tabulated on pages 45 and 46.

Summary of Results

1) Exposure to aerial spraying of malathion did not cause significant cholinesterase inhibition in test bird species. There was little difference in brain ChE activity between pre and post spray specimens. Inhibition in most specimens was less than 20% which is the usual depression level indicative of exposure.
2) The average value of ChE enzyme activity increased slowly with increase of time 8, 15 and 16 days following spraying.
3) The death of one purple martin nestling submitted by a citizen may be attributed to excess cholinesterase inhibition (to less than 50% of normal level).
4) No reports of abnormal bird behaviour or mortality were forwarded from the Rare Bird Alert members.

Brain ChE Activity in Sparrows

Sampling Time	Mean ChE Activity (mU/mg)	Number
Pre-spray	134.5	10
6 hrs. post-spray	128.6	5
12 hrs. post-spray	126.6	5
26-27 hrs. post-spray	127.0	9
8 days post-spray	130.2	6
15 days post-spray	137.7	3
16 days post-spray	150.7	3

Brain ChE Activity in Pigeons

Sampling Time	Mean ChE Activity (mU/mg)	Number
Pre-spray	102.5	9
25-26 hrs. post-spray	107.0	10
9 days post-spray	105.3	10
15 days post-spray	111.0	10

Brain ChE activity in samples submitted by citizens.

Location	Time of Collection	Species	Brain ChE Activity (mU/mg.)
Winnipeg			
209 Colony	1 day post-spraying	Red squirrel	103.3
11 Masterton	1 day post-spraying	Robin	106.0
St. Charles	1 day post-spraying	Red-wing blackbird	107.0
22 Lipton	1 day post-spraying	Purple martin nestling	48.7
22 Lipton	5 day post-spraying	Purple martin nestling	104.0
244 Hindley	a day post-spraying	Grey squirrel	93.3
Brandon	unknown	Mourning dove	72.4

CHOLINESTERASE ACTIVITY IN FISH AND COREXID INSECTS

Malathion is an organophosphorus compound with known ability to inhibit cholinesterase enzymes. These enzymes occur in the nervous system and are used in the transmission of nerve impulses from one neuron cell to the next. When the enzyme no longer functions in its normal role, nervous control of muscles is lost. The consequence of this in vertebrates is that muscles required for breathing stop functioning and the animal dies of asphyxiation.

Three groups of samples were obtained by netting with trap nets or seines before and after spraying. Fish species collected were yellow perch and walleye. Corexid insects (tentatively classified as Callicorixa vulneratta) were captured by dip net in shallow flowing water of Sturgeon Creek.

Adult perch were collected from Fort Whyte Nature Centre before and 1 day after spraying. Young walleye were collected from Bishop Grandin Boulevard retention ponds before and 12 and 36 hours after spraying. Corexid insects were collected from Sturgeon Creek north of Hamilton Avenue before and 1 and 2 days after spraying.

Fish brains were dissected out and stored frozen until analyzed for cholinesterase enzyme activity. Corexid insects were treated in the same way except that there was no dissection of brain tissue; whole insects were homogenized.

Results are tabulated on pages 49 to 51.

Summary of Results:

1) Young walleye taken from Bishop Grandin Boulevard ponds experienced brain cholinesterase inhibition of about 75% (41.2 vs 160.3) relative to pre-spray enzyme values.
2) Adult perch taken from Fort Whyte nature ponds experienced brain cholinesterase inhibition of about 10% (198.4 vs 216.1) relative to pre-spray enzyme values.
3) There was no apparent fish mortality either in the Fort Whyte nature ponds or the Bishop Grandin Boulevard ponds.
4) The corexid insects captured from Sturgeon Creek did not exhibit cholinesterase inhibition either 12 hours or 36 hours after spraying.

Brain cholinesterase activities in yellow perch from Fort Whyte Nature centre.

BEFORE AERIAL SPRAYING		AFTER AERIAL SPRAYING	
Sample Number	Cholinesterase (mU/mg protein)	Sample Number	Cholinesterase (mU/mg protein)
40	284	172	210
41	193	173	178
42	204	174	171
43	196	175	251
44	209	176	196
45	213	177	196
46	181	178	223
47	214	179	160
48	227	180	243
49	197	181	181
50	198	182	180
51	247	183	205
52	214	184	200
53	227	185	197
54	229	186	178
55	214	187	168
56	234	188	193
57	226	189	217
58	197	190	219
59	218	191	203
MEAN	216.1		198.45
STANDARD DEVIATION	22.8		24.06
NO. OF SAMPLES	20		20

Brain cholinesterase activities (mU/mg brain protein) in walleye from Bishop Grandin Boulevard retention ponds.

BEFORE AERIAL SPRAYING		12 HOURS AFTER AERIAL SPRAYING		36 HOURS AFTER AERIAL SPRAYING	
No.	Activity	No.	Activity	No.	Activity
60	123	80	39.7	130	70.2
61	184	81	19.5	131	82.4
62	141	82	26.2	132	51.8
63	134	83	28.7	133	61.0
64	113	84	27.3	134	47.2
65	150	85	47.0	135	63.2
66	166	86	54.4	136	82.5
67	185	87	40.3	137	75.8
68	90	88	42.5	138	23.7
69	180	89	74.1	139	55.1
70	184	90	32.0	140	47.6
71	190	91	36.3	141	55.3
72	169	92	41.0	142	68.4
73	179	93	36.2	143	80.9
74	154	94	45.5	144	93.1
75	164	95	28.6	145	72.6
76	196	96	38.6	146	74.2
77	178	97	39.7	147	65.7
78	141	98	79.4	148	74.2
79	184	99	46.9	149	79.6
MEAN	160.25		41.2		66.2
STANDARD DEVIATION	28.82		14.78		16.1
NO. OF SAMPLES	20		20		20

Whole body cholinesterase activities (mU/mg protein) in corexid insects from Sturgeon Creek north of Hamilton Avenue.

BEFORE AERIAL SPRAYING		12 HOURS AFTER AERIAL SPRAYING		36 HOURS AFTER AERIAL SPRAYING	
No.	Activity	No.	Activity	No.	Activity
100	11.7	115	35.8	150	28.1
101	10.0	116	24.5	151	33.3
102	28.2	117	12.0	152	22.8
103	8.4	118	12.6	153	24.2
104	16.3	119	16.2	154	25.2
105	29.0	120	22.3	155	23.3
106	31.5	121	24.5	156	19.8
107	28.6	122	39.4	157	44.1
108	18.4	123	38.4	158	27.8
109	19.5	124	16.2	159	17.7
110	23.3	125	31.3	160	16.9
111	21.1	126	19.9	161	20.3
112	28.5	127	17.7	162	30.1
113	18.6	128	30.1	163	17.3
114	29.6	129	21.5	164	22.3
MEAN	21.51		24.16		24.88
STANDARD DEVIATION	7.65		9.01		7.17
NO. OF SAMPLES	15		15		15

EFFECTS OF SPRAY PROGRAM ON HONEY BEES AND LEAF CUTTER BEES

The bee monitoring program consisted of:

1) Placing caged bees inside and outside the sprayed areas.
2) Placing honey bee colonies on weight scales inside and outside the spray areas.
3) Visiting apiaries in the spray area.
4) Receiving reports from beekeepers.

Cages made of course hardware cloth (3 mesh/cm) were placed at 18 spray locations. Several bees (usually 25) were placed in each cage and several cages were placed in the spray area. At least two cages with bees were placed outside of the spray areas as controls. The cages were suspended 1 meter above ground in open field areas. In four of the spray zones caged bees were placed at intervals outside of the spray zone to determine the extent of insecticide drift. In two locations caged bees were placed beside (within 1 meter) the Teflon slides used to determine application rates and droplet size in order to determine if there was any correlation between observed mortality and application rate.

In an attempt to gain a better understanding of the effect of the spray program on honey production, weight changes in honey bee colonies were monitored in several locations by placing honey bee colonies on weight scales and taking periodic weight change readings. Control colonies located outside the spray zone were available in some locations.

Results are presented on pages 54 to 57.

Summary of Results:

1) Large numbers of honey bees were killed within or near the spray zones. Most caged bee experiments showed mortality in excess of 80% at or before 12 hours after the spraying occurred (range 34% to 100%).
2) Leaf cutter bees were particularly susceptible showing 100% mortality in some spray locations.
3) Bees located three miles outside of some spray zones were susceptible to damage likely as a result of spray drift.
4) Uneven distribution of the insecticide resulted in differences in observed mortality in caged bees within spray areas.
5) Scale colony data indicated a reduction in honey production for at least 1-2 days following the spray for exposed colonies.

RESULTS OF CAGED BEE TRIALS - 1983 EMERGENCY MOSQUITO CONTROL PROGRAM

LOCATION	TIME OF OBSERVATION (hrs)[1]	CORRECTED MORTALITY (%)[2]	RANGE IN % MORTALITY BETWEEN EXPERIMENTAL CAGES
Swan River	12	100.0	0
Beausejour	8	96.3	82 - 100
Dauphin	3	34.0	8 - 96
Selkirk	12	100.0	0
Dugald	1	81.0	48 - 100
Gimli	1	83.4	40 - 100
Brandon	12	93.6	72 - 100
Altona	5	80.3	56 - 100
Niverville	5	99.6	96 - 100
Morris	15	93.9	76 - 100
Stonewall	4	97.8	92 - 100
Steinbach	12	87.6	0 - 100
Headingley	3	86.6	8 - 100
Winnipeg - East	12	89.5	92 - 100
Winnipeg - West	3	98.8	88 - 100
Winnipeg - Central	12	82.3	56 - 100

[1] This represents number of hours after the spray that the cages were inspected and mortality was recorded.

[2] Calculated as: $\frac{\text{\% survival (untreated) - \% survival (treated)}}{\text{\% survival (untreated)}} \times 100 = \text{corrected mortality}$

Comparison of Caged Bee Mortality with Insecticide Application Rate

Location: Winnipeg - Saskatchewan Avenue - West of Perimeter

Date: August 13, 1983

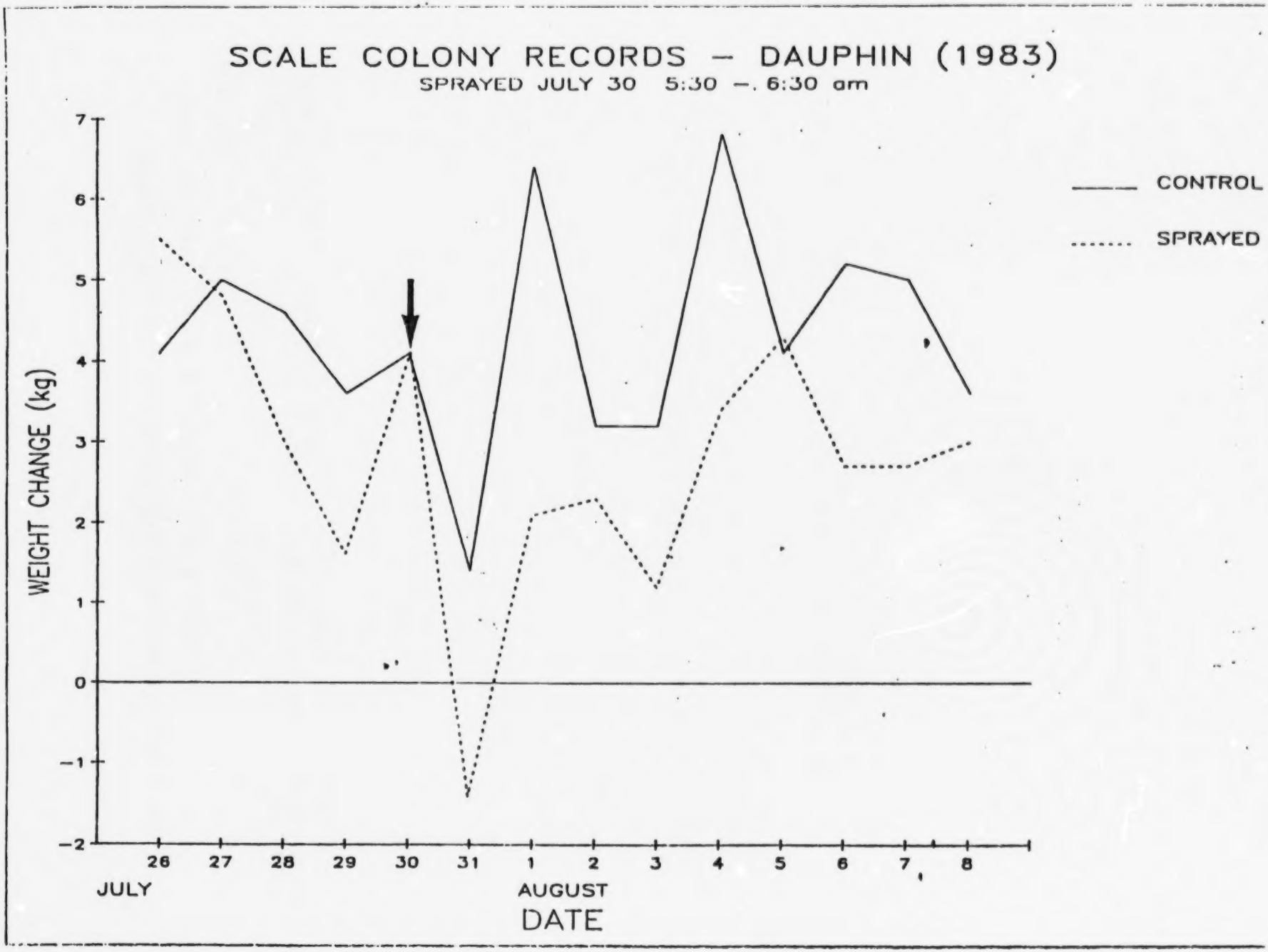
SAMPLING SITES (.4 km intervals)	APPLICATION RATE OBSERVED (ml/ha)	BEE MORTALITY (%) 1 hour	MOSQUITO MORTALITY (%) 24 hours
1	353.0	100	100
2	3.4	0	11
3	324.0	100	100
4	51.0	48	56
5	100.0	84	100
6	202.0	92	100
7	312.0	100	100
8	220.0	64	100
Controls	3 cages	0	1.4

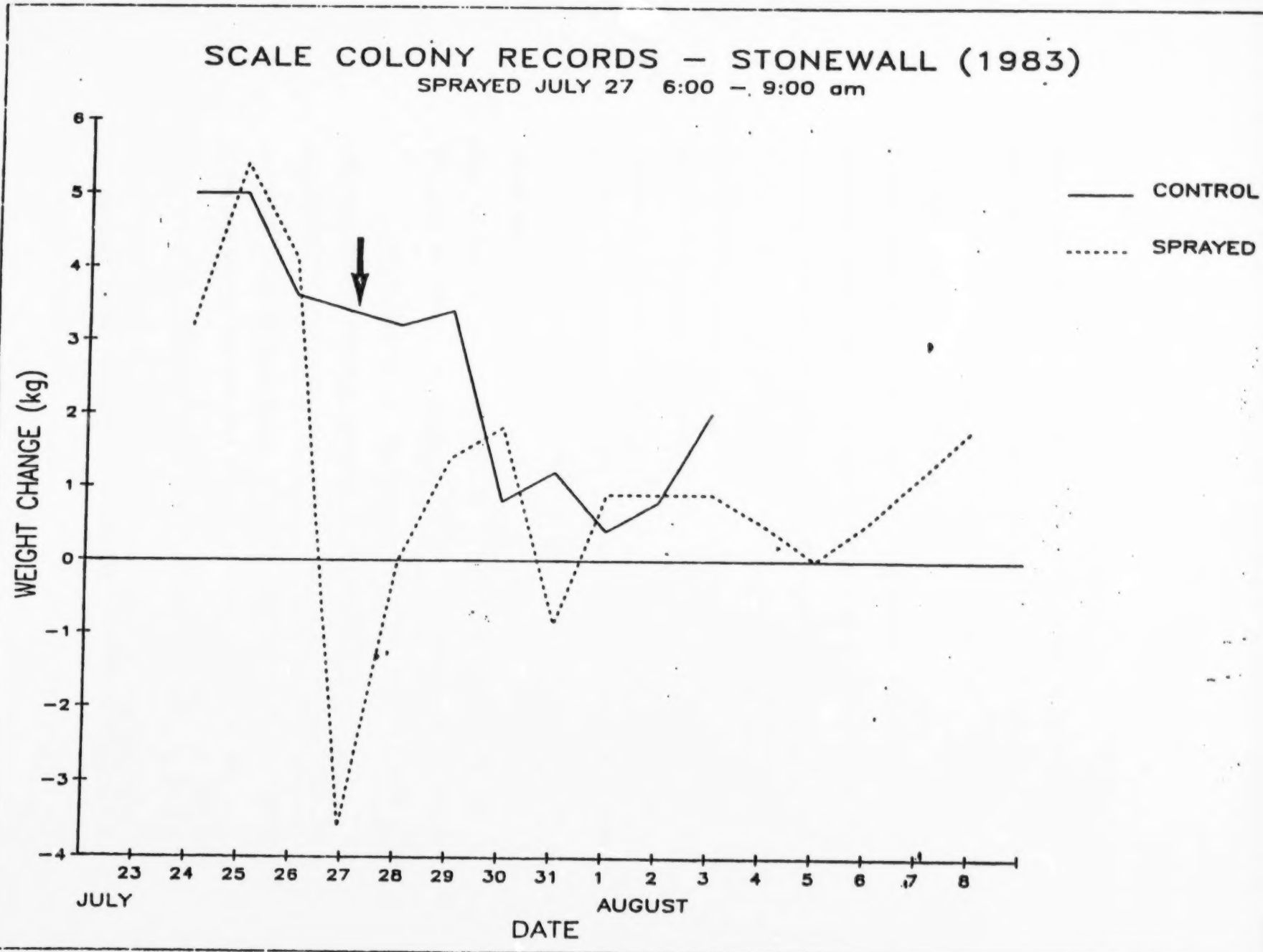
Comparison of Caged Bee Mortality with Insecticide Application Rate

Location: Winnipeg - Bishop Grandin Blvd. between St. Marys Road and Red River

Date: August 14, 1983

SAMPLING SITES (.2 km intervals)	APPLICATION RATE OBSERVED (ml/ha)	BEE MORTALITY (%) 6 hours
1	54	16
2	354	100
3	68	24
4	14	8
5	8	0
6	139	100
7	86	68
8	30	8
9	31	24
Controls	3 cages	0


SCALE COLONY RECORDS – DAUPHIN (1983)
SPRAYED JULY 30 5:30 –. 6:30 am
CONTROL
SPRAYED
WEIGHT CHANGE (kg)
7
6
5
4
3
2
1
0
−1
−2
26
27
28
29
30
31
1
2
3
4
5
6
7
8
JULY
AUGUST
DATE


SCALE COLONY RECORDS — STONEWALL (1983)
SPRAYED JULY 27 6:00 —. 9:00 am
CONTROL
SPRAYED
WEIGHT CHANGE (kg)
6
5
4
3
2
1
0
−1
−2
−3
−4
23 24 25 26 27 28 29 30 31 1 2 3 4 5 6 7 8
JULY
AUGUST
DATE

WESTERN EQUINE ENCEPHALITIS ANTIBODIES IN BLOOD OF NATIVE BIRDS

Blood samples were taken from wild birds caught at various locations throughout the province and analyzed to examine the frequency of virus antibodies. Birds are know to act as reservoirs for the virus. Positive identification of antibodies indicates that the bird was at some time infected by the virus.

Sites selected for monitoring correspond to communities which had been designated for spraying. Three sites were chosen within the City of Winnipeg and in general one site near each of the smaller urban centres.

Blood samples were taken from the wing vein and birds were released after the blood clotted. Blood samples of low volumes were pooled in order to provide a sufficient volume of sera for analysis. Pooled samples were comprised of blood from birds of the same species, sex and age.

In total 294 samples involving 347 birds were submitted for analysis. Of these 253 were of sufficient volume to carry out analysis. Those samples which seroconverted to a 1:10 level or greater using the HI(haemagglutination inhibition) test were considered to be carrying antibodies.

Antibodies to WEE which develop in birds will remain in their sera for a lifetime. Therefore it is not possible to discern between adults which had been in contact with the WEE virus in 1983 or those

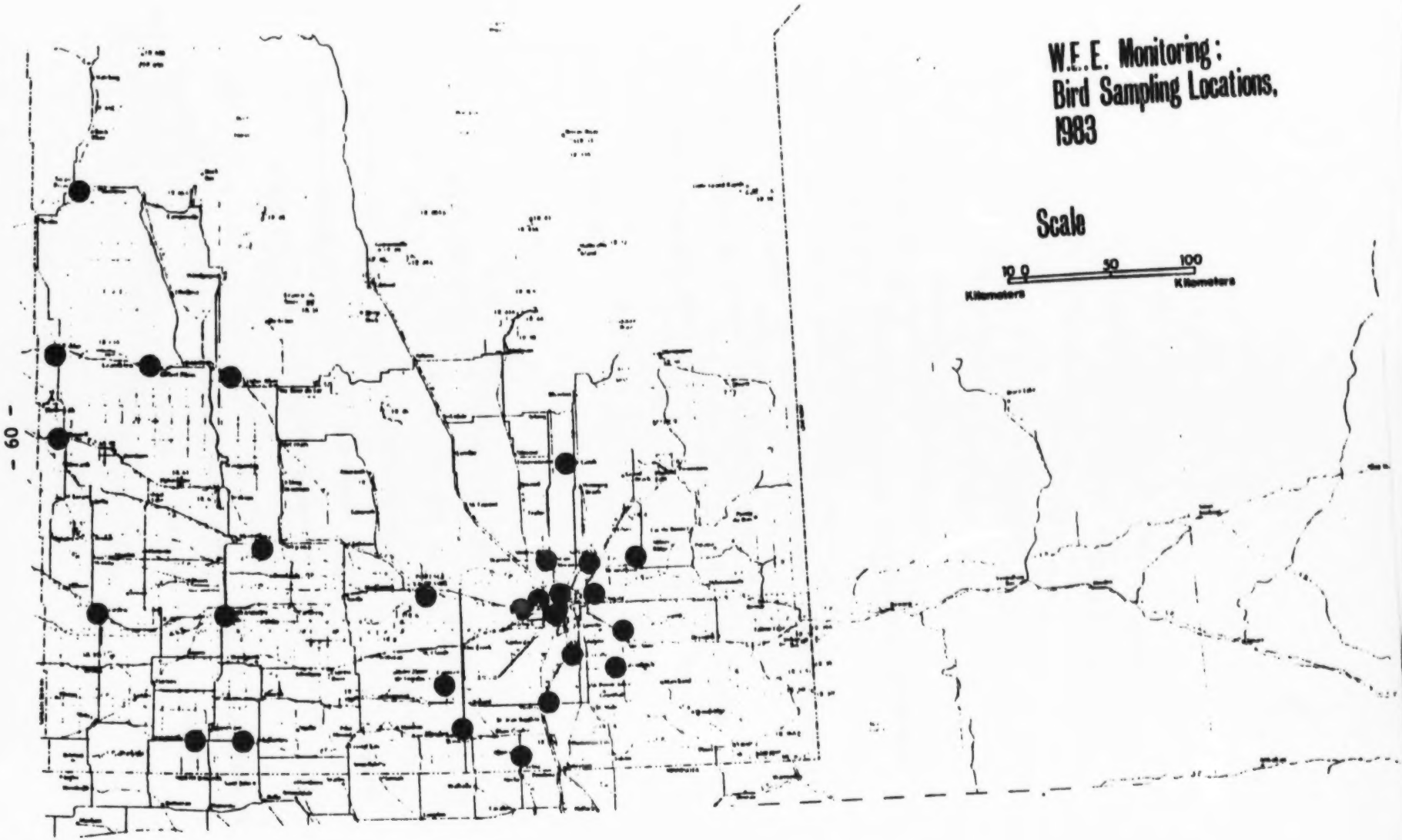
which had been exposed to the virus in previous years. However juvenile birds with WEE antibodies would have contracted the virus in 1983.

Since the time required for detectable levels of HI antibodies ranges from 1-3 weeks following infection it is possible that some of the birds sampled had the virus but had not developed detectable levels of antibodies at the time of analysis.

Results are tabulated on pages 61 and 62.

Summary of Results:

1) Sixteen of the 253 blood samples analyzed indicated presence of WEE antibodies at titres of 1:10 or greater (6.32%).
2) Five of these sixteen were juvenile birds which indicates contact with the WEE virus in 1983.
3) Birds which had been in contact with the encephalitis virus were found in 10 of the 25 communities.


W.E.E. Monitoring:
Bird Sampling Locations,
1983
Scale
10 0
50
100
Kilometers
Kilometers

SUMMARY OF W.E.E. MONITORING IN WILD BIRDS, MANITOBA, 1983.

AREA	DATE	NO. OF SAMPLES COLLECTED	NO. OF BIRDS INVOLVED	NO. OF SPECIES	NO. OF SAMPLES ANALYZED	NO. OF POSITIVE
Winnipeg						
St. James	26/07/83	5	5	1	5	0
St. James	01/08/83	7	7	2	7	0
River Heights	02/08/83	6	6	1	6	0
St. James, River Heights	08/08/83	20	20	3	20	0
Weston	09/08/83	8	8	1	8	0
St. James	10/08/83	3	3	1	0	0
Headingley	03/08/83	6	7	2	4	1
Stonewall	04/08/83	13	19	1	7	0
Selkirk	04/08/83	6	6	1	4	0
Beausejour	08/08/83	14	15	1	12	2
Dugald	08 09/08/83	8	10	2	4	0
St. Anne	10-11/08/83	9	11	3	7	0
Steinbach	11/08/83	12	22	2	10	0
Portage	15/08/83	10	12	5	8	1
Niverville	16/08/83	8	11	3	5	0
Altona	17/08/83	5	5	3	3	0
Morden	17/08/83	11	12	8	11	0
Carman	18/08/83	13	18	1	12	2
Dauphin/Grandview	24/08/83	11	15	2	9	0
Dauphin/St. Rose	24/08/83	10	10	3	7	0
Swan River	25/08/83	12	20	2	12	1
Roblin	26/08/83	9	9	2	9	0
Russell	26/08/83	9	9	2	8	2
Minnedosa/Neepawa	30/08/83	11	13	2	10	1
Brandon	30/08/83	10	11	2	9	0
Killarney/Boissevain	31/08/83	13	13	2	12	3
Deloraine/Boissevain	31/08/83	10	10	1	10	1
Virden	01/09/83	11	13	3	10	2
Morris	07/09/83	9	10	2	9	0
Gimli	14/09/83	10	12	2	10	0
TOTALS		294	347	15	253	16

WILD BIRDS SEROPOSITIVE TO W.E.E., MANITOBA, 1983.

Sample Location	Species	Sex/Age	No. of individuals in sample	HI Titre
Headingley	House sparrow	male ad.	1	1:10
Beausejour	House sparrow	male ad.	1	1:20
Beausejour	House sparrow	male ad.	1	1:10
Portage	House sparrow	female ad.	1	1:40+
Carman	House sparrow	male ad.	1	1:10
Carman	House sparrow	female ad.	2	1:20
Killarney/Boissevain	House sparrow	female juv.	1	1:40+
Killarney/Boissevain	House sparrow	female ad.	1	1:20
Killarney/Boissevain	House sparrow	female juv.	1	1:10
Deloraine/Boissevain	House sparrow	female juv.	1	1:40+
Minnedosa/Neepawa	Vesper sparrow	ad.	1	1:10
Virden	House sparrow	female juv.	2	1:40+
Virden	House sparrow	male ad.	1	1:40+
Russell	House sparrow	female juv.	1	1:20
Russell	House sparrow	female ad.	1	1:20
Swan River				1:40

POOR

QUALITY

ORIGINAL